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Volume 26, New Laboratory Methods for Characterizing the Immersion Factors of Irradiance Sensors

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Chapter 6

Preliminary Results

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Abstract

The continuous and ComPACT methods are intercompared with the traditional incremental method using $I_f(\lambda)$ determinations from various radiometers. The analysis of a series of experiments shows that the continuous method has uncertainties and variability comparable to that of the traditional method. The analysis of the results from the ComPACT and traditional methods shows generally higher $I_f(\lambda)$ values for the former. This is in agreement with the generalized expectations of a reduction in scattering effects, because of the use of pure water with the ComPACT method versus the use of demineralized tap water with the traditional method. The comparison of methods is also extended to the comparison of the JRC and GSFC processors for $I_f(\lambda)$ computations. The results, presented for data taken with the continuous method, show differences to within 0.2%, which are comparable to the repeatability of traditional $I_f(\lambda)$ determinations. Correction values for immersion coefficients determined with pure water, and applied to marine measurements, are also presented and discussed.

6.1 INTRODUCTION

The analysis of the traditional method for $I_f(\lambda)$ determinations, as implemented at the laboratories participating in SIRREX-8, highlighted two significant drawbacks: a) the need for a long execution time, and b) the requirement of large volumes of water. The former diminishes the operational use of the method, because it reduces the number of instruments that can be characterized in a given amount of time, and the latter decreases the reproducibility and accuracy of the measurements, because of the intrinsic difficulty in taking data in water whose properties are not quality assured. Overcoming these two major limitations was the motivation for producing two alternative methods for $I_f(\lambda)$ determination: the continuous method, to save time, and the ComPACT method, to implement a quality assurance capability for water properties. The principal water properties of concern here are those associated with surface particles and scatterers in the water column.

The continuous method makes use of a pump to empty (or fill) the tank, under the assumption of a constant flow rate. The tank emptying (or filling) is carried out in conjunction with the data logging. This leads to the creation of an optical profile, where the depth variable is the varying thickness of the water layer above the sensor. When compared to the traditional method, the continuous method provides a much faster execution of the ensemble of measurements required for $I_f(\lambda)$ determination. In the specific case of the traditional method implemented at CHORS, the execution time can be reduced from 120 min to 35 min. This result immediately demonstrates the operational use of the continuous method for routine instrument characterizations.

The ComPACT method makes use of a very small water vessel for executing the in-water measurements. This makes possible the use of pure water, for instance Milli-Q water, which is easily produced in a laboratory setting. When compared to the traditional method, the ComPACT method can ensure a better reproducibility and accuracy of $I_f(\lambda)$ determinations. These elements suggest that the ComPACT method could be suitable for a standardization of $I_f(\lambda)$ measurements.

The objective of the analyses presented here, aside from a general introduction of the common perturbation elements in $I_f(\lambda)$ characterizations, is to evaluate the differences in results obtained with the continuous and ComPACT methods versus the traditional method.